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Technology and Society on the Verge of Chaos

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Introduction

In this brief note, we consider future technology-society interactions and the roles they may play with regard to ideological movements and violent conflict. We assert—but do not defend—the following societal assumptions: pluralist, free-market, democratic societies are and will be more stable and less violent than less tolerant, less capitalist, less democratic societies; and interdependent and interconnected societies are less likely to initiate violent conflict with their neighbors. Nanotechnology, biotechnology, information technology, and cognitive sciences, collectively known as NBIC[1], and sociotechnologies[2] will lead technical advances over the next several decades. The most revolutionary resultant changes will arise from the convergence of these technologies and the uses people and societies make of them. Significant violent ideological movements spawned directly by technical advances—or in reaction to them—are possible but not likely in the coming decades. The indirect effects of technology on ideologies, movements, and political divides will be far more pervasive.

Technologies will profoundly alter, strengthen and weaken societies and present disruptive opportunities and threats to individuals, factions, and nations. We will explore this first through an illustrative worst-case scenario of technology-society interactions. We will note several trends we expect to hold in the coming decades and their implications. We will consider a potential tipping point generated by the ability of emerging technologies to “humanize” and “dehumanize” individuals and societies, depending upon their application. Finally, we will explore complexity science and the role of systems on the verge of order and chaos in future technical-societal interactions.

A Worst-Case Scenario

In military applications, we envision the remote deployment of swarms of microrobots that are available to locate, track, target and destroy people and machines with little human intervention. For more complex applications, swarms will be guided by groups of people who are enhanced with mental and physical prosthetics and advanced collaboration tools to enable exceptional rapid collective decision making in dynamic, confusing and ambiguous situations. This human-machine swarming collective will migrate from military applications to peacekeeping and law enforcement and then to other sector applications, such as remote monitoring, security, and maintenance of complex machinery and infrastructure.

Small numbers of terrorists or criminals will be able to inflict massive damage on society, including the use of diseases bio-engineered to resist treatment and affect only target populations. Information offense and defense will advance rapidly so that attacks on systems could become continuous and widespread, and lead to frequent identity theft, and the destruction of public confidence in government and financial systems. New missile defense methods will be easily overcome or bypassed with

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missiles launched from short distances or with low-signature air-breathing global attack platforms that can deliver WMD to any place on the planet. Amidst widespread fear of death and destruction, societies will turn to tough, strong protectors as their leaders and will be willing to accept totalitarian states in exchange for the security they promise.

Bloodless combat will also emerge, with energy beams and chemical and biological agents developed to attack or manipulate the brains and nervous systems of individuals or groups with various levels of temporary and permanent damage. This will enable victory without damaging enemy hardware or infrastructure; this is “politics by other means” taken to its logical extreme: changing minds directly.

As we write, people are fretting over their electronic privacy as never before, and yet wiring themselves up with sensors, GPS, and communications and leaving a trail of loosely controlled electronic personal information in their wakes. We expect this ambivalence to continue, and concerns always to be the highest for government-controlled information. Despite civil liberties uproar, the trend is toward the sacrifice of privacy in exchange for convenience and connectivity. Advances in electronics, computers, and communications will enable the deployment of thousands to millions of networked sensors to track anybody or anything anywhere affordably and covertly. Such networks will be able to understand emerging situations and initiate appropriate communications and actions. These networks will have universal application, from calling in hypervelocity precision strike weapons to discovering the whereabouts of devious teenagers.

Sensor networks will eliminate anonymity and fundamentally alter public/private boundaries, reducing individuality and creativity and leading to centralized manipulation and control of societies. Armed with precise awareness and new ways to control people with and without their knowledge, dictators will exercise stifling control and will be very difficult to resist or overthrow.

New forms of wearable networked computers will provide personal enhancement, artificial pleasure, information, and instruction. These technologies could create interconnected societies or, alternatively, leave us sitting isolated at home enervated and mesmerized. Neural prostheses will be used for pain relief or pleasure creation, and individual use of these devices will further limit the productivity and motivation of individuals. The external control of these devices can provide a method to influence or dominate others.

Treatment or prevention of disease based on advances in biotechnology will provide means to extend the lives of the elderly and even preserve the lives of the critically ill leading to increasing costs of health care and a drastic reduction in the opportunities and flexibility available to younger generations. New methods of reproduction or cloning will result in engineered humans without family ties and perhaps without empathy or a sense of responsibility or commitment to other, lesser humans.

Self-replicating machines and bioengineered materials that can grow under natural conditions without limits will cause unexpected environmental changes. Nuclear proliferation will accelerate and nuclear explosives will be available and used for extortion as well as occasional attacks.

As the global climate begins to change rapidly for poorly understood reasons, the most fragile societies will not be able to adapt, and this will lead to economic collapse, the spread of infectious diseases, and mass migrations to neighboring states. Fear of migrants with untreatable diseases will lead to genocidal methods for self-protection and increased isolation of even wealthy countries. Many nation states without economic sustainability will revert to tribal governance. Rapid fluctuations in climate will deplete stored water supplies and prevent crop production leading to famine. Compact distributed nuclear reactors will be built and deployed to deal with the escalating energy and water

needs, but they will be sabotaged and their materials stolen to supply rogue states, criminal gangs, and terrorist needs for nuclear weapon materials to deter and hold hostage the rapidly declining former superpower states.

Trends in Technology-Society Interactions

Some ideas above seem likely—even inevitable—to us, while others are more far-fetched or even ludicrous. The safest prediction is always that current trends will continue; in that spirit, we offer the following:

1. Sensing, communications, and information technologies will fundamentally change privacy and social interactions.
2. Advances in neuroscience, nanoscience and genetics will challenge current conceptions of what it is to be human, and will result in new means to access and manipulate others' thoughts and feelings, likely without their knowledge.
3. Technologies that enable the few to have disproportional effects on the many will continue to emerge.
4. Technology will play an important supporting role as both cause and cure for future economic, environmental, demographic, political, and social crises.

New means for a very few to disrupt and destroy the many will fuel and transform criminal and terrorist behavior and pose stiff challenges to the ability of governments to maintain order and legitimacy. New means for the few running a totalitarian government to oppress their many citizens will result in opportunities for unprecedented oppression. Together, these trends will change the ways in which political power can and will be exercised. Technology can enable the following: communication and relationships among people; new and increased human capabilities; increased self- and group expression; a stronger sense of identity and self-worth; increased curiosity, learning, innovation, and creativity; and collective understanding and productivity. Often the same technologies can be "dehumanizing" (disempowering, homogenizing, and mind-numbing) or "humanizing" (flexible and adaptive). Machines can make humans feel superhuman or unnecessary. They can give us access to new and wonderful experiences or turn us into an audience of others' experiences. Humanizing applications of technology strengthen the social fabric, make societies resistant to upset and attack and enable the stability and success of pluralistic, free-market, democratic governments. These applications also erode support for totalitarianism and ideologues. Reactions to dehumanizing technologies may create many future ideologues and will certainly create a pool from which they will draw recruits. At the same time, dehumanizing applications of technology will hypnotize and anaesthetize the hapless victims of terrorists and totalitarian dictators. This self-reinforcing dichotomy suggests a tipping point.

The techno-doom future could arise at the convergence of social, economic, and political trends that are amplified by the nano, bio, info, cogno, and societal technology revolutions. But another future could arise, that harnesses the opportunities derived from these technologies while benefiting from a little chaos and complexity.

Natural systems often exist at the verge of order and chaos. These systems are quite resistant to purposeful attack. They are differentiated, dynamic, and yet stabilized by a large number of interdependent variables. This creates redundancy and makes it very difficult to anticipate or influence their state with any precision. These systems endure countless minor upsets and occasional catastrophes, but have tremendous capacity to recover. Financial markets and the internet are examples of artificial systems that share many of these characteristics. They are flexible, agile, self-organizing, and self-correcting. Such systems may be able to avoid the emergence or at least the

worst consequences of the techno-doom scenario. Too much order is highly efficient but totally tuned to current conditions. It results in brittle structures vulnerable to any change in the environment. Overly ordered systems lose their differentiation and redundancy and become vulnerable to single-point failures. Their behavior can be anticipated and predictably influenced by a purposeful attacker or manipulator. In human systems, too much order enables absolute power to corrupt leaders, who will have all the instruments of techno-doom at their fingertips.

A more flexible, adaptive, and even chaotic societal framework would allow for continuous small changes that maintain a quasi-equilibrium—a social resilience—rather than the abrupt large-scale instabilities that can occur when societies are governed single-mindedly without the natural restoring forces of self governance, rule of law, and democratic institutions. Such societies should be able to ride the waves of technology changes (and other disruptive changes) without falling victim to cataclysmic upsets. These societies would be confusing and chaotic, difficult if not impossible to steer, and would have countless inequities and inconsistencies. But they would be resilient and resistant to the power of the few—the few terrorists, the few mafia, the few evil dictators.

Conclusion

Technology and society are complex, interacting phenomena. In this note we have presented a bleak picture of how maladaptive societies might apply new technologies in ways that are destructive to human well-being. These same technologies could be used by adaptive societies to meet stressing challenges and enhance well-being. The actual story that unfolds will probably be neither totally bleak nor totally bright. It may be possible to contain crime and terrorism while preserving individual freedoms. Health technologies may not only extend life expectancies, but also extend productive lives. As in the past, many new technologies will produce both social goods and social ills. Some societies will make better and more humane use of technology than others. Good outcomes are more likely for complex adaptive societies perched on the verge of order and chaos.

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[1] *Converging Technologies for Improving Human Performance - Nanotechnology, Biotechnology, Information Technology and Cognitive Science (NBIC) Workshop Report*, Mihail Roco and William Sims Bainbridge (ed.), NSF/DOC-sponsored report, June 2002

[2] G. Yonas and J. Glicken Turnley, "Socio-Tech…The Predictive Science of Societal Behavior," in Mihail Roco and William Sims Bainbridge (ed.), *Converging Technologies for Improving Human Performance Workshop Report,* June 2002, pp. 140-142

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